ENGINEERING EDUCATION

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Society for the Promotion of Engineering Education

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PRESIDENT'S FOREWORD.

The American Engineering Council of Federated American Engineering Societies at its meeting in Washington last month adopted the following resolution.

"For a century engineers have directed their energy toward the utilization of the physical forces and the materials of nature. The developments which they have brought about have created an epoch in human history.

"While these develcpments have been of inestimable benefit, and modern society could not exist without them, they have introduced many public problems and social readjustments so closely related to the engineer's activities that it is increasingly evident he must assume an active part in their solution.

"Recognizing this growing need, the engineers of the country formed the Federated American Engineering Societies, primarily to place their knowledge and training at the public service on all public matters affecting engineering or affected by it.

"The Federated American Engineering Societies, therefore, speaking for the engineering profession, urges upon engineering colleges an increased attention to the social aspects of engineering activities, and a broadening of their technical training in every way possible, to develop in engineering students the spirit of and a capacity for active leadership, not only in industry but in public affairs."

This pronouncement by the most comprehensive organization of engineers together with the active interest shown by the leading societies in educational activities, such as the educational papers at the annual convention of the Mining Engineers this month and the joint session of the Civil Engineers with our Society last month, all indicate the interest which is being taken by practicing engineers.

The ideal set for the engineering school is a high ideal. It is not definitely defined, or rather it differs in accord with the ideas of the individual or the group which makes the definition. But they are all in practical agreement in calling

for bigger and broader men for larger tasks. A committee of one of the societies found that among the views of three score engineers there was only one advocating more specialized courses for fitting men for particular jobs.

Industrial leaders are asking for men with capabilities for development rather than preparation for specific duties.

How are the new conditions to be met? Certainly not by some revolutionary or miraculous transformation but rather by an evolution from what now is. Even if a definite ideal in engineering education were agreed upon which might involve changes in the curricula and faculty and methods they could not be instantly adopted. The ideal should be a growth from within. The study of what engineering education should be and the undertaking of means which will bring it about is a part of the function of every teacher and every faculty. Much can be done by general coördination and aid but the real and substantial progress will come as each teacher and each school uses its best endeavors to develop its ideals so that it may best perform its particular part in promoting engineering education.

THE YEAR BOOK.

The March number will be the year book. Cards were sent to each member asking for corrections and the return of the card. Quite a number of the members have not responded with the result that their names will appear in this year book just as they appeared last year. Corrections can not be made after February 21. The names of new member received after this date, will be printed on a page in the back of the book, but their names will not appear in the "Geographical" or "Occupational" distributions.

THE ENGLISH DEPARTMENT.

During the past month the English committee through its chairman has sent out to the secretaries of all the sections and branches of the Society the request that the subject of English and its relation to the rest of the engineering curriculum be made the subject of discussion at one of the section or branch meetings during the year. It was also suggested that inasmuch as the meeting at Urbana last June resulted in the formulation of what may be regarded as the creed of the committee this statement of the ideals upon which we are agreed be used as a basis for detailed consideration. The replies received have indicated how alive engineering teachers everywhere are to the importance of English training in the preparation of our students for professional service. They have also indicated how much interest there is everywhere throughout our engineering colleges in the problem of correlating that training with work in the technical and scientific subjects. The time seems to have passed when any one with childish faith hopes that the injection of a few courses in English into the otherwise solidly technical curriculum will provide the mystic power to render our graduates cultured men and at the same time give them mastery of their most necessary tool—the use of their native speech. It is coming to be realized that the student's training in the expression of his ideas must be contemporaneous with his acquisition of those ideas, that he must be patiently but persistently made to perfect his ability to say what he has to say. Moreover as he grows in the understanding of his professional subjects, he must be given glimpses into a variety of fields of human thought and human endeavor, his horizon must be broadened, he must feel his larger relationships, he must be given new interests and new powers to appreciate. All this means that the largest effect of training in English composition, and of the study of English literature can only be realized in the engineering colleges by a

perfect correlation of that work with the technical courses. The problem is fascinating, because it is so comparatively new and so difficult. All this rather clear appreciation of the importance and the real character of the problem is evident in the letters I have received from the branches and sections.

I should like to suggest that during the next two months, as we begin to look forward to another conference at Cornell, the faculties of our engineering schools make the three conclusions reached by our committee at Urbana the subject for one meeting. If this is not in all cases practical, it would seem reasonable that every group of English teachers concerned with the instruction of engineering students hold at least one round table discussion of the report.

Lest in some cases a copy of the report may not be available, I will quote the three conclusions to which I refer:

1. Our objective is identical with that of all teachers of English, *i.e.*, to develop the student's ability to express himself both orally and in writing with simple effectiveness; to enlarge his fund of ideas, and to increase his ability to classify those ideas; and finally, to create a sincere taste for discriminate reading and to develop standards of critical judgment.

2. Our method of approach must be to begin from and build on the professional interest of the student.

3. Our method of procedure must be to establish at all points the closest possible inter-relationship between the instruction in English and that in professional subjects.

The practical problems involved in the third conclusion are especially worthy of consideration.

May I ask that wherever sections, branches, faculties or English staffs do engage in the discussion of the correlation of English with the technical studies, some one be deputized to communicate to the English committee briefly the conclusions reached. If copies of the entire report of the English committee are desired, they may be obtained from the chairman, J. Raleigh Nelson, 927 Forest Ave., Ann Arbor, Michigan.

THE ANNUAL MEETING.

The Cornell meeting, June 20 to 23 inclusive, promises not only to have the largest attendance, but also to be the most important meeting ever held by the Society. The new activities of the Society, the increased membership, and the work of the Board of Investigation and Coördination all promise interesting developments at the meeting. We may expect important announcements from the Board at this time.

The following have been appointed a Local Committee on Arrangements:

W. N. Barnard, *Chairman*,
A. S. Barnes,
C. L. Walker,
H. Diederichs,
F. O. Ellenwood,
P. M. Lincoln,
J. G. Pertsch, Jr.,
D. S. Kimball,
H. S. Jacoby.

The following are some of the suggestions already presented to the Program Committee: Have you any to add?

"That one or more papers on the content of a combined five-year curriculum in engineering and commerce by men who have had practical experience in it would be timely."

"A 15- or 20-minute talk along the line of executive ability, giving a keen analysis of the big essentials, both from an analysis of the work and the men."

"The general sessions be held in the evenings and that during the day all the delegates meet in small committee groups for conference purposes."

To the Members of the Council.

Gentlemen: I am giving you, herewith, a letter which we have just received from Professor Barnard, chairman of the Local Committee for the Ithaca Meeting.

"On December 12th, I wrote you that our Commencement would probably be changed to an earlier time than

originally scheduled, which might have some bearing on the dates to be selected for the Meeting for the S. P. E. E. Although our Commencement has now been fixed to occur on Monday, June 18, the Comptroller of the University states that preparations for housing the members of the Society in University buildings can not be completed before Wednesday of that week. *Hence we suggest that the meeting begin June 20 and extend through the remainder of the week.* Will this be satisfactory for the Society?''

Several members have suggested that the Society hold its meetings so that the members attending the meeting may have the opportunity of spending Sunday at the Institution. It has been decided, therefore, in view of the above letter, to have the opening meeting on Wednesday afternoon, June 20th, and to have the closing meeting Saturday morning June 23rd. This will then allow the visitors to spend Saturday afternoon and Sunday at Cornell for, ''rest, relaxation, recreation and religion.'' This also affords a perior of rest before the A. I. E. E. meeting at Swampscott, Mass., and the A. S. T. M. meeting at Atlantic City the following week.

F. L. BISHOP,
Secretary.

EMPLOYMENT.

The Secretary's office would be glad to receive notices of vacancies which will occur in the various schools at the end of the present school year. In sending these notices, give as much information as you can so that we may secure for you only such men as are interested in the position.

Any member wishing to make a change at the end of the school year, should also send in a statement of his training, experience, age and any other information which will be useful to us. The minimum salary should also be included in your statement and your preference as to location.

The annual meetings are clearing houses for this information. There you will meet the men who need men in their different schools and the personal contact gives both a better knowledge of conditions than can be secured by correspondence. Time and money spent in attending the annual meetings is money well invested.

FINANCIAL STATEMENT OF THE SOCIETY, JANUARY 15, 1923.

To the Members of the Executive Committee, Messrs. Scott, Wiley and Bishop.

Gentlemen: I am giving you herewith a statement of the income and expenses of the Society from July 1, 1922 to January 15, 1923:

Receipts.

Balance on hand June 29, 1922		$ 394.06
Interest on deposits		14.02
Received since June 29, 1922:		
Current dues	$4,811.50	
Back dues	200.00	
Sale of publications	257.76	
Advertising	1,621.77	
Advance dues	23.00	
Exchange	.10	
Contributions	87.00	6,401.13
Total receipts		$6,809.21
Accounts Receivable:		
Advertising	$ 333.25	
Dues of members	3,985.00	
Total accounts receivable	$4,318.25	

Disbursements.

New Era Printing Co. Inc.:		
September Bulletin	$ 263.13	
October Bulletin	238.79	
November Bulletin	452.93	
December Bulletin	368.92	
	$1,323.77	
Expenses of Secretary's office	975.04	
Other expenses	284.21	2,583.02
Balance		$4,226.21
Paid New Era Printing Co. on old account		3,716.72
Balance on hand Jan. 15, 1923		$ 509.47
Accounts Payable:		
New Era Printing Co.	$2,015.33	

Very truly yours,

F. L. Bishop,
Secretary.

REPORT OF INSTITUTIONAL DELEGATE OF OREGON AGRICULTURAL COLLEGE.

To the President.

Sir: On June 6, last, you did me the honor to appoint me as the official delegate of the Oregon State Agricultural College to the annual convention of the Society for the Promotion of Engineering Education to be held at the University of Illinois, June 20 to 23.

I attended the convention and beg to submit the following as a report of the same. Two hundred and ten persons were in attendance from all parts of the country, the most complete representation naturally coming from the colleges in the northern part of the Mississippi Valley. There were three from the Pacific coast—Professors J. C. L. Fish and H. H. Henline from Stanford University, and the writer from Oregon Agricultural College.

President C. F. Scott presided at the opening session, Tuesday afternoon, June 20, in the lecture hall in the Physics building, and delivered the keynote address of the meeting, viz., The purpose of the Society is to develop teachers who can develop engineers.

The program of papers and speakers is given in an appendix to this report. These papers have been published in the *Journal of the Society for Engineering Education,* or will be published, together with discussions of the proceedings of the annual meeting.

The papers were all good, the discussions being animated and to the point which added to the interest and value. The talk of Dean Cooley at the smoker, impromptu though it was, proved to be one of the most notable events of the meeting. This talk is published in the September number of Engineering Education. The social events of the convention were most delightful.

Two very important sessions were held in connection with the meeting, the meeting of the deans of the middle-west and the meeting of the teachers of English. The first culminated in a division of the Society composed of deans and administrative officers who are members of the Society. The teachers of English were planning to organize late in the year.

Two or three outstanding points may be mentioned:

The insistance that engineering students shall be able to express themslves fluently and accurately in English, both spoken and written.

The insistance that engineering students shall have more cultural training in history, literature, economics, etc.

That pedagogical training of teachers of engineering subjects is desirable and should be insisted on more and more firmly. They must be trained not only in engineering subjects, but also in the art of teaching.

That to retain good men in engineering faculties and induce young men of promise to enter a teaching career the college must meet the competition of the commercial world, pay better salaries, and give better working conditions.

After this convention of the Society for the Promotion of Engineering Education the writer attended the convention of the American Institute of Electrical Engineers at Niagara Falls, Ontario, where an evening session was devoted to papers on Engineering Education and discussion of them.

The writer than proceeded to Cambridge Massachusetts where he took a course on General Principles of Education in Harvard University Summer School. In this course he received a grade of B, and was an auditor or visitor in a course on Principles of Economics.

In his travels to and from Cambridge he visited the drafting rooms of the following universities, colleges, and industrial concerns to get information and ideas on Mechanical Drawing, his subject at the Oregon State Agricultural College: University of Wisconsin; University of Illinois; Case School of Applied Science; Nela Park Laboratories; Union University; General Electric Company and American Loco-

motive Company of Schenectady, N. Y.; Harvard Engineering School; Massachusetts Institute of Technology; Sheffield Scientific of Yale University; The Pratt & Whitney Company, Hartford, Conn.; Columbia University, N. Y.; and the Newport News Shipbuilding and Dry Dock Company, Newport News Va.

He picked up such ideas as came along in a journey of some 11,500 miles from Corvallis to Vancouver, B. C., Oldtown, Maine, Palm Beach, Fla., Calexico, Cal., and back to Corvallis.

Respectfully submitted,

MORRIS WENK.

LETTER TO THE EDITOR.

My dear Professor Bishop: I feel I can not get along each month so well as I should if I do not read all of my BULLETIN. The collection of arguments for and against and regarding the coöperative system is an asset to me. The recent articles on Drawing were a gold mine of inspiration. One difficulty confronting us in our C. E. course is the variable preparations of entrants as regards mathematics. What subjects should a man be excluded from, rigidly, I mean, in a thorough C. E. course, if he has not passed, or studied, mathematics through analytic geometry? That's a small question, but a few expressed opinions would be gratefully received. I am

Sincerely yours,

PERRY M. TEEPLE.

UNIVERSITY OF SOUTH CAROLINA.

CITY PLANNING FOR ENGINEERS.

BY WM. T. LYLE,

Professor of Civil Engineering, Washington and Lee University.

In the revision of curriculum at Washington and Lee University to conform to the accepted conclusions of recent educational investigations, a shortage of time is being felt, as is the case elsewhere, for technical courses of merit in the junior and senior years. The pruning of technical information courses which have flourished more in the branches than at the root was a distinct step in advance. On the other hand we believe that there are highly specialized subjects which are worthy of attention, not so much as information courses, as for their great educational value, using the word "educational" in its strict derivative sense.

One of these subjects is city planning. At this institution we do not give a full-fledged course in city planning as a part of the Civil Engineering curriculum, but offer three illustrated lectures on the subject and encourage those seniors whose inclinations lie in this direction to choose city planning theses. This year they have chosen Memphis, Tennessee, as a subject. The conditions there will be investigated and a plan prepared. This plan will include the street system, parks and boulevards, the water front, surface and steam railways, passenger and freight stations and a zoning plan.

City planning possesses certain educational merits which have not hitherto been grasped. It is a subject preëminently fitted to convey to young men's minds the nature of a modern engineering which has transcended old ideas based on materials, forces and technique. We are dealing now with other forces also, and our young men must understand that there are sociological and economic problems connected

with an engineering project, fully as important as the calculation of stresses and the proportioning of materials. Furthermore the modern engineering, dealing as it does with big problems, recognizes a mutual dependence of the different elements and a powerful influence of other matters outside of the problem proper. Of all subjects which may be used to illustrate these ideas to the minds of university students none is better than that of city planning.

In its preparation the city plan requires an engineer of broad gauge and well balanced judgment, for the city plan is a big problem and a problem consisting of parts each one of which exerts a powerful influence on the others. Thus we have the park system consisting of parks and boulevards which cannot be designated without regard to the street system and often to the question of water supply where the parks and park reservations constitute a watershed for the municipal water supply. The street system bears heavily on problems not only of local transportation, but also on those of railroads and freight and passenger stations. These in turn are dependent on the requirements of business and manufacturing and often on that of water transportation. The housing problem, which in other words is largely a problem of the reduction of labor turnover, is thus bound up in problems of industry and commerce, and all three in that of a comprehensive zoning which powerfully operates to stabilize real estate values to the benefit of business and homestead alike.

City planning as a study for students also possesses other most desirable educational properties. When practised it develops the faculty of design. The designing of cities is designing in its highest sense and requires a mental activity and ingenuity far superior to that required in some other of our more prosaic engineering problems. Then too city planning invariably stimulates the student's interest and creates a wholesome enthusiasm for his work. This is especially true if the example taken is the student's home town. Furthermore in work of this kind the student himself bridges

the gap between the college cloister and the field of business and construction by bringing about in his own mind an attitude of interest and independent thinking which bids fair to bring him success and prominence as an engineer and man of affairs. No young man can hope to reach the top of the ladder unless his interest and concern are closely identified with the activities of the world in which he lives. No young man can attain the highest success without this attitude which is fundamental to aggressive leadership.

THE PLACE OF MENTAL GROWTH IN THE COLLEGE PLAN.

Suggesting a New Attitude and a Revised Procedure.

BY GEORGE W. MUNRO,
Purdue University.

Quite naturally the statement by President Hopkins of Dartmouth that "opportunities of higher education ought to be increasingly restricted to an aristocracy of brains, composed of the intellectually alert and eager, if democracy is to become a quality product rather than one of quantity" has resulted in much discussion both in educational circles and in the daily press.

While much of this discussion is marked by loose thinking and a very vague understanding of what constitutes a college education and of the function of the college in the educational scheme, the very general interest testifies to the timeliness of his remarks.

When he says "it consequently becomes essential that a working theory be sought that will coöperate with some degree of accuracy to define the individuals who shall make up the group to whom, in justice to the public good, the privilege shall be extended, and to specify those from whom the privilege should be withheld," he has evidently opened up one of the most difficult of present-day college problems.

That the demands on our colleges and universities have recently increased much faster than their resources and that the future seems to offer no relief, is a condition which can not much longer be ignored. To continue to further enlarge sections, overwork instructors and use inadequate laboratory facilities is only to invite pedagogical disaster. While few believe that too many can secure a higher education, most of us are confronted by the undoubted fact that some limitation

must be put on college attendance and at present we *do* lack a working theory upon which to select the individuals "*in justice to the public good.*"

The formulation of such a working plan must be preceded by an analysis of the elements which constitute the essentials of higher education so-called, and of the prime functions of the college in their attainment. Until these points are understood and agreed upon, discussion of ways and means of accomplishing fundamental reforms is futile.

Attendance at college is an opportunity for continued and extra mental growth. The usual college course is a deliberate four year extension of the period of infancy to provide for uninterrupted mental development. It should properly result in a class of men of outstanding ability—mental giants as it were.

Removing a boy from school at an early age and setting him to work is the most certain way of making a physical and mental dwarf, conspicuous examples to the contrary, notwithstanding.

When through high school a boy has nearly attained his physical growth and his mental development should be better than the average. He takes his place among well developed men.

While there is a well-defined limit to physical stature, there is no known pituitary body limiting mental development. Given proper conditions a man should continue to develop mentally during his whole life. These proper conditions for continued mental growth it is the primary business of the college or university to supply. Inquiry naturally follows as to proper conditions for mental development.

The requirements for physical growth are food, air and exercise. Without them normal development is impossible and every growing child must utilize its proper portion of each. No less essential to normal mental development are mental food, proper "atmosphere" or environment and mental exercise.

It is then the business of the college to supply:

1. *Mental food.*—A proper supply of the information acquired, the problems solved and the best thought of the world; for mental growth, like physical, comes only by retracing the development history of the race.

2. *Atmosphere.*—The proper "atmosphere" for an educational institution consists of that stimulation to mental effort which comes from contact with others engaged in mental effort and especially from contact with those who are older and farther advanced but who are yet going on. It is the daily contact in class and field and laboratory with men of ambition, of attainment and of vision, be they students or instructors.

3. *Exercise.*—Mental growth is conditioned quite as much on the student doing for himself mentally as is physical growth dependent on his physical activities. There should be supplied in every subject, therefore, a goodly number of problems or exercises of proper grade for the student to master by his own effort.

Of these three coördinate factors in mental growth, mental food, mental stimulus and mental exercise, the college as such has primarily been concerned with the first. It has properly spent much effort and money in securing an adequate library, arranging suitable courses and selecting the best material to use in the courses offered. In short, great care has been exercised in the selection of the mental diet.

Less attention on the whole has been paid to the inspirational environment or "atmosphere" in which the student works. When recognized authorities have been secured as teachers and mild encouragement been given to student literary and technical societies, the usual measures for "atmospheric control" have been taken. Some institutions of collegiate grade have a military form of organization intended to "make every day a good day" but these seem to be decreasing in number from decade to decade.

In the matter of mental exercise, however, the college as an organization has almost entirely failed to make any definite provision or assume any responsibility. It is true that it

expects each instructor to provide such problems or exercises as may be needed in connection with his class work but that these mental exercises shall be made progressive throughout the period of residence and that they shall be coördinated as between subjects and departments as is the subject matter, has never been seriously undertaken.

With the idea that the essential part of a college education is continued mental growth; that the necessary conditions for such growth are an adequate supply of mental food, proper stimulation and mental exercises suitably graduated, also that it is the primary business of the college to supply these essentials; let us glance at the actual conditions encountered.

William R. Wilson says: " . . . in the typical university class the inter-quartile range extends from students who in general intelligence and in information test well below the average high school senior to students who are not far below the mental level of the average graduate student. In intelligence and information 10 per cent. of the class test below the medium high school junior, 10 per cent. will test at the average level of those who graduate with distinguished honors. In the light of such facts, 'raising the standards to make the bright students work' becomes nonsense, unless the instructor is willing to weed out the lower one half or three fourths of his class."

We all know quite well that college chemistry cannot be taught to a student unable to grasp ordinary problems in proportion, that in calculus a student is hopeless who has no idea of maintaining an equation, and the man whose sole idea of the boiling point of water is 212 degrees is soon quite out of his depth in thermodynamics. Yet every section in every class in college contains misfits no less striking.

Every hour that we teach we are faced by men who could easily master the work in a third of the allotted time and by others without either hope or desire of mastering anything in any time. The energies of the instructor are mostly given to the lower third; not with the idea that what they learn will ever be used, but rather that he may conscientiously give them

passing grades. Meanwhile those in the neglected upper third are being trained in the gentle art of loafing and in habits of general slovenliness which will endure for life.

With this brief statement of the problems the colleges face, the functions they endeavor to perform and the difficulties encountered on the way, it is here proposed that the colleges seek a new viewpoint from which to attack the many problems which now so sorely vex. With a restatement of aims, the acceptance of new ideals and the utilization of new methods, it should be possible for the colleges to inaugurate a new era of leadership and service.

The following theses, related but not dependent, are proposed for discussion:

1. *The process of education is the process of mental growth. Attainment of a certain mental level should mark one as of college caliber and progress in education should be measured in terms of mental development.*

2. *The qualifications of a student to begin a subject are of more importance than are considerations of when its pursuit should cease.*

3. *Mental exercises as a factor in mental growth are quite as important as are physical exercises in physical growth and it is as important to coördinate them throughout the course as to arrange the subject matter progressively.*

I propose for discussion the central idea that the essential part of a college education is mental growth to a recognized mental level; that course content and years in residence are relatively unimportant except as they are necessary requirements of mental growth; that progression should come only by demonstration of adequate preparation and ability to engage in the succeeding work, each subject being actually taught on its own level with drill on prerequisite levels discontinued.

In the past we have undertaken to set a minimum as to what a man should *know* at entrance to college and have started in to add to that store of knowledge; testing from time to time to see that the allowable minimum was being attained

and retained. Our college courses have been laid out with the idea that there is a definite minimum of chemistry, physics, mathematics, history and economics which a man must needs possess as a working equipment in his chosen field of endeavor. Actually we have always recognized that a man who took this minimum of chemistry, secured a passing grade of 70 per cent. and spent a summer at home or at work, comes back in the fall without *any* working equipment in chemistry. Tacitly we have acknowledged that such equipment was unnecessary for we have passed this man on from year to year to graduation contenting ourselves with the reflection that he had received a certain amount of *training* in the subject, whatever that might mean.

My proposal is that we frankly face the fact that acquired knowledge is not and has never been *the* important factor, one might almost say *an* important factor in education. The important thing in education is *mental growth* and the acquiring of knowledge is only the necessary means to this end. With technical and professional schools the subject matter is so arranged as to give familiarity with some of the underlying principles and some slight skill in the technique of the work. While this is of great importance, no degree of mastery is expected of the graduate until after some years of apprenticeship training. Every technical teacher knows how utterly impossible it now is to impart a knowledge of even the rudiments of his subject in the time allotted and under the present conditions of class makeup. His acknowledgement of this and of the importance of mental development in the educational scheme usually takes the form of the statement that he tries to teach the boys to think.

In the accordance with the view that the attainment of a certain mental level should mark one as of college caliber, I propose that entrance to college work shall be based on the possession of a certain mental maturity or development. With the assistance of the department of applied psychology there would be established an entrance mental level for the school. The candidate presenting evidence of certain secondary school

work would be admitted for classification. His first period, say two months, would provide him opportunity to demonstrate that he could work ordinary arithmetic problems, could keep an equation balanced, could tell when a proposition in plane geometry was proved and could tell where he lived, with a degree of precision sufficient to enable a cabman to locate the place in daylight.

At the end of this period he might be given a little card stating that an X-ray analysis of his mental machinery showed him a fair sixth grader in arithmetic, a fourteen-year-old child in reasoning ability, a semi-skilled tradesman in manual dexterity and a poor fourth grader in knowledge of words and ability to express thought. He would be advised that no place existed in the university curriculum for the instruction of men with those mental attainments but that many secondary schools were fitted to benefit earnest students of that entering grade.

Before college instruction proper has begun occurs the elimination of the manifestly unfit by means of a thorough course in mental measurements. These would be taken during a review of subjects prerequisite to the following college work and would be well worth the time of those to go on.

At entrance and at each successive stage, the students would be passed over the proper psychological screen and sorted as impartially as fruit is graded and as accurately as the then available technique would permit.

I propose that college courses be designed and coördinated with the idea of having the student advance from one mental plane to the next progressively. Examinations would be set to determine the mastery of fundamentals for the subject it was proposed to undertake next; always with the forward view. The problem would always be to get into the next subject, never to get out of the present one. This would require a different technique for different subjects; let me illustrate by a possible procedure in my own.

A student now presenting credits for two years English, five semesters mathematics, one year each of chemistry and

physics and a semester study of engines and boilers is assigned to thermodynamics without further question as to his fitness to profitably pursue the work. At least a half of the men so assigned have no working knowledge of the mathematics or sciences and every part of the work must be administered on the assumption of complete ignorance of the prerequisites, else a half of the class is completely lost from the start.

Under the proposed arrangement the candidate would present himself and be given a short test consisting of an arithmetic problem or two, some algebraic transformations, a problem involving logarithms, an algebraic function to differentiate, an area to find by integration, a question on the temperature of steam, a combustion equation to balance and a simple question on the operation of a steam engine or boiler. With that paper in hand ten minutes would determine whether he would be an asset or a liability in thermodynamics; whether he was master of the fundamentals and had reached the thermodynamic level. I leave to the imagination the effects on the student attitude and morale throughout the previous period of university work.

As before outlined, one of the prime conditions of mental growth is proper mental exercise. The recognition of this is so general as to be almost universal. Every textbook has "exercises" and "problems" in connection with the text. The recognized use of our laboratories and shops is to furnish exercises to the mind and not until we come to institutions frankly trade schools do we find manual skill the dominant note in instruction.

Despite this widespread recognition of the "learning by doing" principle and the repeated assurance we both give and receive that education is a self-development by doing and not something imposed from without, our colleges have paid very little attention to the provision and arrangement of the necessary material.

It is in connection with this somewhat neglected branch of college athletics, mental exercise, that I propose that the other propositions shall be made to function. It is proposed that

these exercises receive cognizance from the college and have the same attention and care given to their selection and coordination that the subject matter of the courses have. The exercises would then as now provide the blackboard work, the home work to be handed in and the questions for the written lessons in each subject. They would differ from those now in use only in that they would be devised with a broader vision; with all of the preceding and all of the succeeding work of the course in mind.

It is a matter of common knowledge that many of the problems now required are secured with little effort. Frequently they are worked in groups where a leading mind is the directing force and occasionally they are copied outright. Under the proposed method such dependence on others would result in certain disaster not long delayed. With the focus on course content a man may pass with a smattering; with mental level as the criterion, no less than a mastery will suffice. Neither physical nor mental exercises vicariously performed will result in development.

The present pass system is based on a minimum absorption of course content; ability to cram down and retain temporarily a certain amount of mental food. Little or no attention is paid to its digestion and absorption into the psychical organization. Fortunately most young persons have good mental digestions and actually do make good progress under a systematic food cramming and haphazard exercise scheme. Instead we should have a plan of systematic exercises so designed and coördinated that, performed faithfully as assigned, there would result the proper digestion and assimilation of the mental food and the symmetrical growth and development of the intellectual person.

While the exercises are designed with the primary idea that they shall constitute the scaffolding by means of which the student climbs from one educational level to the next, they would at the same time furnish the basis for many of the tests for advancement. For example, all of the questions mentioned in the illustration of preliminary test for thermody-

namics might well be taken from exercises previously used in the various subjects.

Some of the results of such a system can be predicted.

In the first place there would be a considerable rejection of unfit candidates at the very beginning. At the least estimate between one and two tenths of our entering freshmen are definitely below college grade at entrance. Thirty per cent. fail in one or more subjects the first year; a full third have left with scholastic failures by the end of the second year while about sixty per cent. of any entering class fail to graduate. Yet in spite of this amazing record of elimination we are daily confronted by men below college grade in our senior classes. The trouble is that we have very poor safety devices to keep the unfit from getting in and clogging the wheels of our educational machinery. Rather we allow them to remain in the gears until we wear them out. Frequently a man more than usually persistent remains five years or longer and never attains the mental level of a good high school senior. The system as proposed would exclude these "traffic gummers" at the start and would provide that "working theory which would define with accuracy the individuals to whom *in justice to the public good* the privilege of a college training should be extended, and to specify those from whom the privilege should be withheld."

Another effect would be to always keep students associated with their mental peers. The "atmosphere" would be that of association with men going in the same direction and at about the same speed. The race would always be close, which in itself incites to effort on the part of the participants.

Also, the parasitic student and the lazy student would be eliminated early for mental growth can only result from proper exercises personally performed. There is no royal road to learning though there sometimes seems to be to a university degree.

With the elimination of the unfit, the parasite and the loafer, the course content could be enlarged and extended so that students would actually acquire greater knowledge. They

would depart with more tools in their kit and all of better quality and with keener edge than at present.

The most natural and pertinent question in connection with the proposed scheme is regarding the means at hand for determining mental levels and educational progress. Have we the standards or a reliable method of setting them up?

During the last five years a vast amount of work on mental measurements has been done in every school below college grade. This work has provided standardized tests suitable for all subjects in every grade and has developed a well defined norm for each. The general college policy of ignoring individual mental differences has failed to provide the incentive to carry this work into the field of higher education. Although the standards are not yet completely established, the methods are well developed and a sufficiently trained personnel is available to secure results as rapidly as they are needed. With an active interest shown in the work, there is no reason to believe the matter of methods and standards would stand in the way.

Undoubtedly there is a very decided aversion which I confess to sharing, to basing admission to college on so-called "intelligence tests." The feeling that in them the race is to the swift rather than to the strong is very general and frequently well founded.

This objection would not hold with a carefully observed review of work previously taken and presumably mastered. There the thorough student could be expected to show to advantage over his naturally quicker but more superficial rival, and when all is said, much of our best thinking is done by slow thinkers; men whose answers are slow in coming but are well considered and correct. These men must by no means be excluded from college.

Correlating and graduating the problems and exercises of a whole university course of study has less of established method as a foundation. Real effort is made to introduce the various subjects in logical order of development and in order of their increasing difficulty. Some attention is also given to

seeing that the same subject matter is not included several times under different course names. Due, however, to the continued presence of incompetents, it is necessary to repeat essential portions of the work at frequent intervals with waste of time and loss of coördination in the course. No really serious effort has been made to coördinate the whole course content, including exercises, on the basic assumption that all previous basic work has been really mastered and that incompetents have been eliminated *before* and not *after* the administration of the work. That the work could be so planned I am confident, and that it would result in a more extended and a more unified course seems logical. Doubtless some of our present conceptions of a college education would be gradually altered, including the one that all students require just four years of thirty-eight weeks to acquire one.

Just now discussion centers on what can be done for the student of exceptional ability. I offer as the first and most practical solution that each university class be made up of men actually prepared to undertake the work of that class and that the really qualified man be relieved of the discouraging, ambition blasting, soul deadening, repetition necessitated by the presence of incompetents to whom the world seems to owe, for reasons unexplained, a diploma at the end of four years.

I recognize that man is a social being and requires good manners; a physical being and requires a good body; a religious being and requires spiritual development: for these and other interests due provision must be made. However, the main concern of the college is that students are intellectual beings looking for development of the mind. That is why they are students; the *raison d'être* of the college. To provide for that development is its business and none should be neglected, not even the best. It may properly set standards, low or high, outside of which it does not offer instruction but within its accepted field every student is justified in expecting that he will be provided with the real essentials of mental growth.

A LABOR-SAVING METHOD OF DUPLICATING PROBLEMS FOR ENGINEERING STUDENTS.

BY H. L. WHITTEMORE,

Formerly Professor of Mechanics, University of Oklahoma.

Much of the hardship in teaching is due to the mental and physical exertion required to give students a clear understanding of the work to be done in preparing for the next recitation. For some subjects, such as history and literature, assignments in the text may satisfy all requirements. For engineering subjects, it is usually conceded, problem work is a necessity if the student is to obtain a proper grasp of the subject. If numerical problems are assigned, with an engineering setting, they increase the student's interest and also leave in his memory definite applications of the principles which are of great assistance in using his school training later in life. These often require drawings or diagrams which greatly increase the work required of the instructor.

The practice of putting problems on the blackboard, to be copied by the student and solved for the next recitation is not only an unwarranted waste of the student's time but the answers will be incorrect if errors are made in copying the problem. For the most efficient instruction, each student should be supplied with a statement of the problem.

In modern business, a careful study has been made of methods for duplicating letters. Without them, the present mail order business would be impossible. These methods are not well adapted for problem work, as they lack the necessary flexibility and drawings or diagrams require considerable work.

Careful consideration of the requirements of problem duplication, led to use of the method described here. It is hoped that it may prove useful to others.

A problem, once put in satisfactory form, with its accompanying drawing if any, should be reproducible at will. Tracings, from which blueprints or other copies may be made, are perhaps the only practicable form. In order to use a typewriter for the text, a standard sheet, 9 inches wide and 12 inches long, has been chosen. A margin of ¼-inch on each side and a division of the sheet into horizontal sections, 2¾-inches high gives room for an average problem in each section. If necessary, two or more sections can be used for a single problem. In order to allow for binding, as described later, a margin of one inch is allowed at the left and next to it a 3-inch space for the drawing, if any. With this arrangement of the sheet, the typewriter can be used to the bottom of the lowest section, without having the paper slip, as one inch at the bottom is unused. Completed problem sheets of this kind are shown in Figs. 1, and 2.

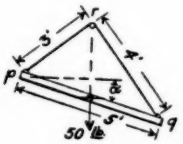
A paper free from preparations likely to cause the paper to become brittle with age but sufficiently transparent to blueprint readily should be used for the originals. A thin bond paper, such as Mather–Lamm, is well suited for the purpose. With the Hammond typewriter, the size of type may be used which suits the requirements. Although the value of this feature may easily be overestimated, it is often of considerable advantage. In order to obtain a satisfactory impression from the typewriter, carbon paper is used so as to leave an impression on the back of the sheet. After trying many carbons, Carter's Professional Typewriter Carbon Paper, Standard Weight, 7 lb., Hard Finish was found to be very satisfactory. The carbon impression is a dense black so that good blue-prints are obtained, but the impression is not easily smeared. Of course, water-proof drawing ink is used for the drawings and a black record ribbon for the typewriter.

After a sheet is completed, the sections may be cut apart, forming sheets 2¾ by 9-inches, which may be filed, vertically, like cards, in numerical order. If the problems were on larger sheets, they would be apt to crumple in a

vertical file, which is, probably, the most convenient way to care for them.

The uniform bar pq is 5-ft. long and weighs 50-lb. It is supported from the pin r in the wall by the string pr, 3-ft. long and the string qr, 4-ft. long.

Find the position of equilibrium of the bar, that is, find the angle which the bar will make with the horizontal.

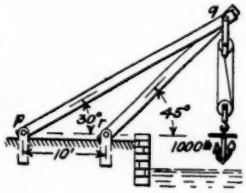


The two weightless bars, pq and qr, are pinned together at q and to the foundation at p and r. A load of 1000-lb. is supported at q.

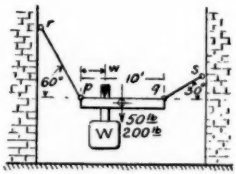
(a) Find stress in each of the two bars.

(b) Find the forces which the foundation exerts on the bars at p and r.

(c) Find the forces which the two bars and the load exert on the pin q.



The uniform bar, pq, weighing 50-lb. is supported by the two cords as shown. A 200-lb. weight is to be placed on the bar to bring it to a horizontal position. Find the distance pw for the correct position, and also the cord tensions, with the weight in place.



The bar qs, supporting the 600-lb. weight, is pinned to the strut at r and the frame is pinned to the floor at q and p.

(a) Find all the forces acting on the bar qs and on the bar pr.

(b) Find the forces which the frame exerts on the floor at q and p.

(c) Find the forces which the bars exert on the pin r.

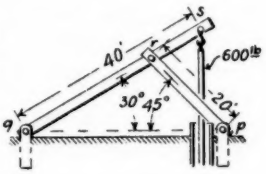


FIG. 1.

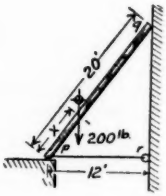
Any number of blue-prints from these tracings may be filed and used for black-board assignments, during recitations or for quizzes and examinations. If desired, all members of a student section may have the same problem or each may have a different one. If the blue-print is collected with the solution, few will be lost and the cost of replacing these will be small.

For home assignments, it is practicable to supply students with sets of problems for the entire course and make a charge to cover the cost.

The 20-ft. weightless ladder rests against the smooth floor and wall as shown. The cord pr, holding the ladder in position has a tensile strength of 50-lb.

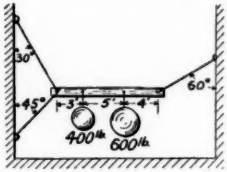
(a) How far up the ladder can a man weighing 200-lb. climb before the cord breaks.

(b) Find the forces which the ladder exerts upon the floor and on the wall, in (a).



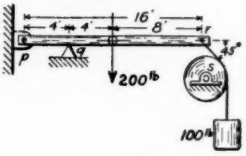
This weightless bar, rs, is held horizontal by the three cords, pr, qr and st, and carries the two loads of 400 and 600-lb.

Find the stress in each of the cords.



The uniform bar pr weighs 200-lb. It is held in position by the pin p in the wall, the support q and the cord at r which passes over the frictionless pulley s and supports the load of 100-lb.

Find all the forces acting on the par pr and also the force which the pulley exerts upon its pin at s.



The car pq which with its load weighs 20-tons stands, as shown, on the 50-ft. bridge rs. The bridge weighs 20-tons.

Find the forces which the piers exert on the bridge at r and s.

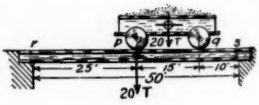


FIG. 2.

A better way is to prepare a list of lesson assignments for the course with all the instructions and problems, except those found in the text. This list, typed on tracing paper, 9 by 12-inches, and backed with carbon, might read as follows:

January 16, Wednesday.

Chapter VII, paragraphs 3 to 11, inclusive. Check values for the problem solved in the text. Problems, text 41, 45; assigned, 71, 156, 3, 4.

The assigned problems could then follow the lesson assignments, as four of them make a 9 by 12-inch sheet. No entirely satisfactory method of fastening the problems together has been devised but transparent labels have been used gummed in the margin at each side.

Instead of blue-prints, reproductions may be obtained by processes using printer's ink on white paper. If a sufficient number is required this is the most satisfactory as the copies are more legible and much more permanent. Notes can also be made on the white paper, more easily than on the blue-print paper.

The use of sheets, each containing one problem, filed and handled like a card catalog and from which copies may be secured in any number either separately or in sheets of four for binding with other material, is the distinguishing feature of this problem system.

The labor involved in preparing the problem sheets is small compared with that needed to put the same problem on the board several times or to reproduce it repeatedly in other ways. It is believed that a system of this kind will encourage the use of problems chosen by the instructor for the particular needs of his students.

It is advisable to avoid assigning the same problem too often, as solutions are supplied by students who have completed the course. A schedule may be prepared which will assign problems to the best advantage, thus:

Lesson 4, Problems, 12, 48, 137, 139, 145, 175, 195
Lesson 5, Problems, 3, 17, 18, 29, 63, 71, 480
Lesson 6, Problems, 47, 79, 81

This shows the lessons for which additional problems are desirable and the schedule can be arranged so that only part of the problems for any one year are assigned for any subsequent year.

If problems are to be filed in this way, the solutions should also be available, as they are usually required by the instructor for class room use. A Moore loose-leaf binder for sheets 5

by 8-inches, is convenient. A very desirable paper is Bryon Weston's linen ledger which is permanent and which is excellent for either pencil or ink drawings.

Examples of answer sheets of this kind are shown in Figs. 3, 4, 5 and 6. As every instructor has his own ideas about

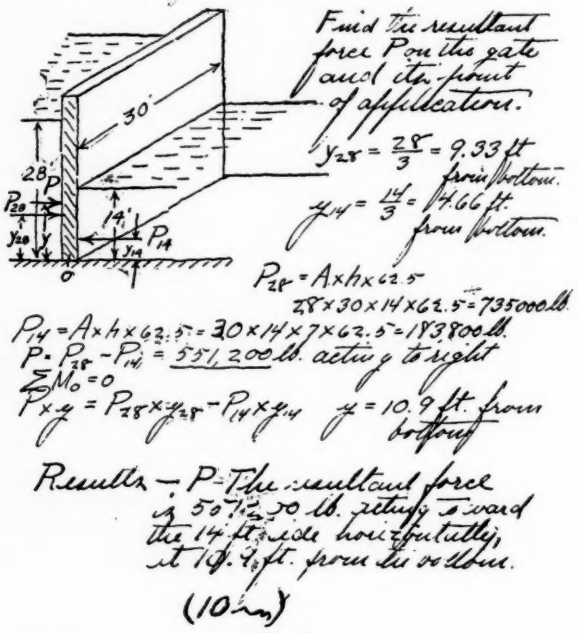

Find the resultant force P on the gate and its point of application.
30'
28'
14'
P_{28}
P_{14}
$y_{28} = \frac{28}{3} = 9.33$ ft from bottom.
$y_{14} = \frac{14}{3} = 4.66$ ft. from bottom.
$P_{28} = A \times h \times 62.5$
$28 \times 30 \times 14 \times 62.5 = 735000$ lb
$P_{14} = A \times h \times 62.5 = 30 \times 14 \times 7 \times 62.5 = 183800$ lb.
$P = P_{28} - P_{14} = 551,200$ lb. acting to right
$\Sigma M_0 = 0$
$P \times y = P_{28} \times y_{28} - P_{14} \times y_{14}$ $y = 10.9$ ft. from bottom
Results — P = The resultant force is 551,200 lb. acting toward the 14 ft. side horizontally, at 10.9 ft. from the bottom.
(10 sq)

FIG. 3.

the arrangement of work of this kind, no suggestions need be made here.

If the methods outlined here, assist any instructor to carry on problem work more effectively or to reduce the drudgery of the task the purpose in presenting them will have been fulfilled.

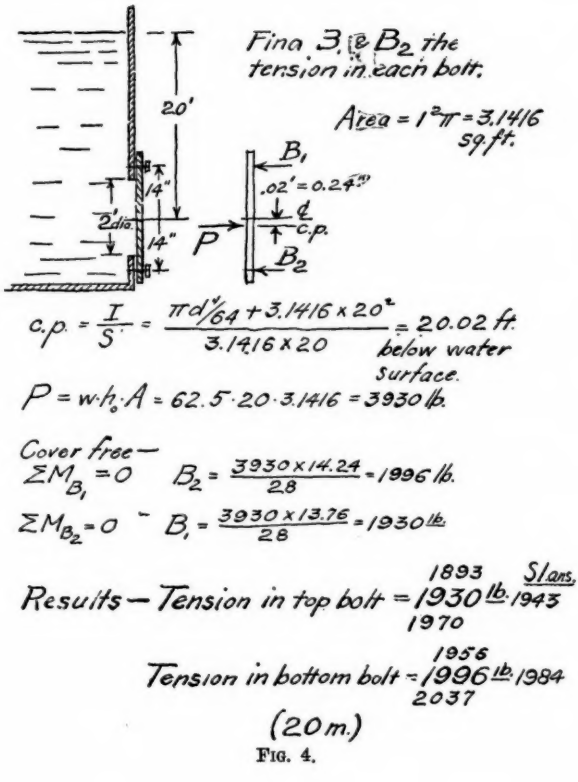
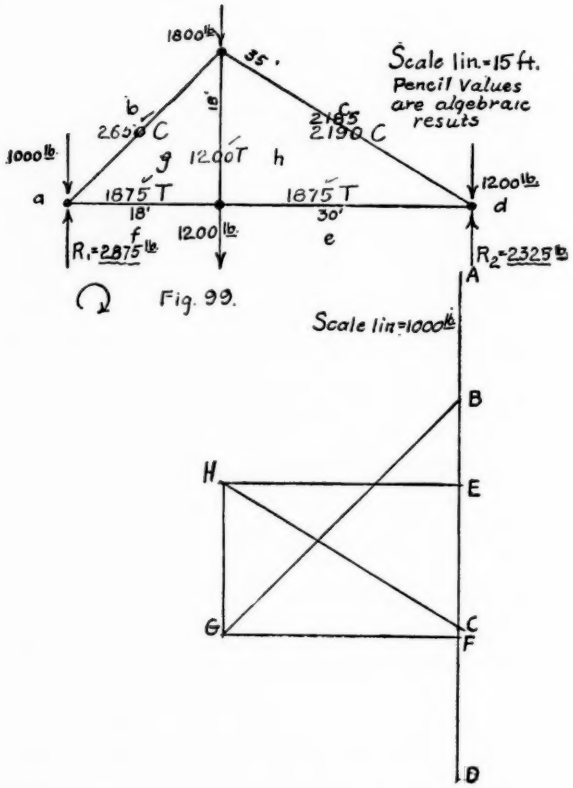
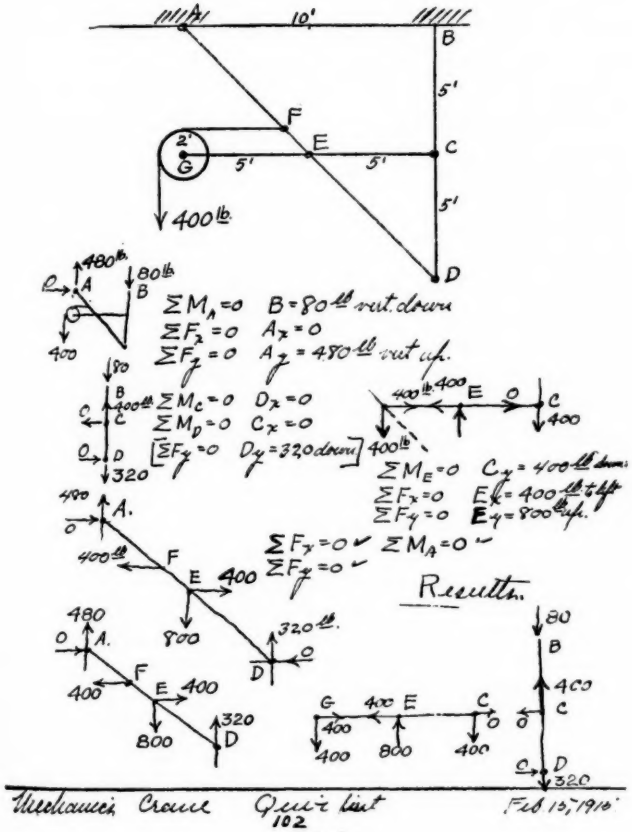

Find B_1 & B_2 the tension in each bolt.
Area = $1^2\pi = 3.1416$ sq. ft.
20'
14"
2 dia.
14"
P
B_1
.02' = 0.24"
d
c.p.
B_2
$c.p. = \frac{I}{S} = \frac{\pi d^4/64 + 3.1416 \times 20^2}{3.1416 \times 20} = 20.02$ ft. below water surface.
$P = w \cdot h_o \cdot A = 62.5 \cdot 20 \cdot 3.1416 = 3930$ lb.
Cover free —
$\Sigma M_{B_1} = 0$ $B_2 = \frac{3930 \times 14.24}{28} = 1996$ lb.
$\Sigma M_{B_2} = 0$ $B_1 = \frac{3930 \times 13.76}{28} = 1930$ lb.
Results — Tension in top bolt = 1893 / 1930 / 1970 lb. Slans. 1943
Tension in bottom bolt = 1956 / 1996 / 2037 lb. 1984
(20 m.)

FIG. 4.



Mechanics Truss Maurer 3d. p. 62. Fig. 93. changed Feb. 8, 1915.

FIG. 5.



Mechanics Crane Quiz List Feb 15, 1910
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FIG. 6.

A BONUS SYSTEM OF COLLEGE SHOP MANAGEMENT.

BY F. H. SIBLEY* AND A. W. PRESTON.†

The object of shop courses in educational institutions is in general, two-fold. First, to acquaint the student with the fundamentals of construction, devoting as little time as possible to detail. Second, to familiarize him with modern commercial shop systems and practice. Of the two, the latter is perhaps the more important, yet this phase of the work has frequently been given little attention.

The time that can be devoted to shop work in most Engineering Colleges makes it difficult to carry on such work on a commercial basis. Some form of systematically arranged exercises must therefore be resorted to in order to give the students a fair knowledge of work that can be done on the various machines. Such exercises are always open to the criticism that the training obtained is only theoretical and to the further objection that the exercises themselves do not arouse the interest of the student.

A considerable number of years experience in Engineering College shops leads the writers to believe that the above objections are valid but that after all has been said the exercise method is generally the most satisfactory compromise to be had. Commercial work turned out by students who put in from three to six hours per week on the job is likely to be of small value unless there is a sufficient number of skilled mechanics working along with them to oversee and check up on their work. This is usually not possible in a small shop where the instructional force is nearly always limited.

Following is a brief description of a method by which both objects set forth at the beginning of this article are accom-

* Dean, College of Engineering, University of Nevada.
† Ass't Professor of Mechanical Engineering, U. of N.

plished and which at the same time meets the criticism of the exercise method, in so far making it more practical and satisfactory. Under its operation the student covers a third more ground than he did before it was inaugurated. Since he does his shop work under a system very similar to those now in use in commercial shops, using the regulation time clock and job tickets, and methods of determining labor costs of manufactured articles, he becomes familiar with modern shop practice.

Under the system the college shop becomes more truly a laboratory, the emphasis being put on method and the operation of machines rather than getting out a job, always of questionable value. It further relieves the instructor of much tedious detail which can as well be done by a shop clerk, thereby giving the former more time for instruction. Another advantage lies in the bonus which keeps the student from loitering and results in more and better work. The student knows at all times his earnings. He practically grades himself and as a result cannot be dissatisfied with his final mark. Throughout the course the student is a shop workman and learns to see things from a workman's standpoint. This enables him to be a better director of labor, a position which he naturally expects to attain.

On registering a student is considered to be in the employ of the instructor for the semester at a specified rate with the understanding that he may get a bonus through discipline, speed and excellency in his work. He is then assigned a shop number and given a time card, on which (by means of a time clock) he registers his time upon entering and leaving the shop.

After the student has recorded his time on the time card and placed it in the proper card rack he proceeds to the shop clerk, is assigned a job, receives a job ticket, and proceeds with the work under instructions written on the blue print furnished. A portion of the job ticket is kept by the shop clerk who records the time thereon, and a portion is given the student who returns it when the job is finished.

A BONUS SYSTEM

The principal object of the system from the instructor's point of view is a fair means of grading at the end of a semester, the following method has proved very satisfactory. The laboratory periods are two and one half hours long and sixteen periods or forty clock hours constitute a semester credit. For convenience twenty-five points per hour have been selected as the rate of pay for the student's attendance; then forty clock hours multiplied by twenty-five points per hour will give 1,000 points for each semester hour of credit. This makes grading very simple. Assuming that the student has been present every period, it is only necessary to point off one place or divide by ten, per credit, to get 100 per cent. grade for attendance.

Both the amount of work done and its quality are considered in making up the grade. Each job has a definite time allowance for completion. This is called "Standard Time." This standard time was obtained by taking the average time required by a large number of students to complete the same piece of work. Sufficient assignments of work are then introduced into the course to fill a semester of forty hours.

If a student completes all of the work within the standard time and each piece is marked first class, he will earn 1,000 points on his work, this is then reduced to a grade in the same manner as explained for attendance. If he completes the work and it is passing but not first class, 25 per cent. of his points are deducted from the grade. If less than 75 per cent. of the course is completed, the student is restricted in his registration the following semester; if less than 60 per cent. is completed, he has failed.

If a student completes the course in less than the standard time, the time so gained is considered a bonus. This automatically shortens his semester's work.

To compute the final grade, the attendance is taken from the time cards, the points earned on jobs are given by the time from the job tickets on file and the extra material and broken tools are taken from the requisitions. All of these

items are computed each week and recorded on the Total Shop Record. This Shop Record devotes one sheet to each student and gives his record for the whole course. In computing the grades the credits are added together, and the debits are added together. The debit is then subtracted from credit leaving the balance as the points earned. In the case of a one hour or one credit course, the sum of the points earned is divided by twenty to reduce results to a percentage. In case a student is taking two credits, it is necessary to divide by forty.

The system has been in satisfactory operation for some years at the University of Nevada, where the average number of students enrolled in shop courses is about one hundred, the instruction being given by one full time instructor and one part time instructor with the assistance of a part time clerk, who also acts as tool room man.

A more complete description of this method was published in the *Manual Training Magazine* for October, 1920, to which reference can be had.

* Shop forms may be obtained by addressing either of the writers, University of Nevada.

MECHANICAL DRAWING AT PURDUE UNIVERSITY.

BY F. P. McGRATH AND L. BRITTON,

In Charge of Mechanical Drawing at Purdue University.

Since the period of the recent war there seems to have been a decided change in the method of presentation of the course in mechanical drawing at Purdue University, that is compared with the method as given by Robert F. Edgar in his article on "A Review of Drawing From S. P. E. E. Proceedings, 1893–1921" in the November, 1922, issue of the S. P. E. E. BULLETIN and with the object of reporting the current practice in mechanical drawing at Purdue University this article is presented.

For a number of years past, those at Purdue who were interested in the teaching of mechanical drawing have felt, that due to the courses offered in the high and manual training schools throughout the country, that there was an ever growing demand for a more advanced course in the University, for those students who have completed the high-school work.

It was a recognized fact that if credit were advanced to the student, he was left with just that much time on his hands which he seldom used profitably and further if he took advanced Sophomore work, he was creating a condition of irregularity which was very detrimental to himself and was an everlasting source of annoyance to the University authorities.

Since the work mechanical drawing was of such a vast importance to the student, it was decided that credit would be given only when the student could demonstrate his knowledge of the science, as well as the art of the subject and we might say on that account very few credits are advanced for mechanical drawing at this Institution.

MECHANICAL DRAWING AT PURDUE UNIVERSITY.

In preference to giving of credit, there was organized at Purdue some four or five years ago a course in advanced mechanical drawing, which parallels the regular course in time required and credit given and this advanced course was opened to all students having 200 hours of high-school mechanical drawing or an equivalent in practical experience, while the regular course was for all students having less than the prescribed amount. The sources are therefore presented in the following manner:

In general, drawing may be divided into two classes, viz; Art, which implies drawing from the standpoint of freehand rendering, the purpose of which is usually to represent the beauty of the object drawn. And engineering drawing which implies, drawing by the aid of mechanical instruments, whose purpose is to give information for the reproduction or building of the object represented.

To the engineer or scientist the subject of art, outside of its æsthetic value, holds but a passing interest, while engineering drawing as a tool in the hands of a well trained engineer is indespensible. However, it seems as if its importance in an engineers' equipment is not as fully appreciated as it might be.

Engineering drawing might be defined as the art of graphical representation and the science of points, lines and surfaces. And as a subject taught in the high or preparatory school it would be advisable to teach it from the standpoint of the art, or the "how" of drawing, leaving the science, or the "why" of drawing to the college or university.

The advanced course at Purdue University as outlined and presented deals largely with the science of the "why" of drawing for it is felt that the student with 200 high school hours of drawing is well versed in the art or the "how" of the subject.

The work of the first semester is covered largely by lectures and only sufficient time is devoted to laboratory to enable the student to fully understand the application of the theory as presented in the lecture. The time devoted to the first semes-

ter's work is 108 hours and the course is presented according to the following outline:

(*A*) *Engineering Drawing:*

(1) Orthographic Projection:

(*a*) Freehand lining and lettering.

(*b*) Construction of engineering curves.

(*c*) Theory and development of orthographic projection.

(*d*) Application of orthographic projection to the making of working drawings.

(*e*) Theory and application of isometric and axinometric projection and drawing.

(*f*) Theory and applications of oblique, cabinet and diametric projection and drawing.

(2) Scenographic projection:

(*a*) Theory and practice of two and one point perspective.

(3) Freehand Sketching:

(*a*) Application of different types of drawing to the making of freehand sketches.

(4) Reproduction:

(*a*) Tracing and blue printing.

(*b*) Hectographing.

(*c*) Lithographing.

In the second semester of the advanced course, 25 hours of the allotted 108 hours are devoted to the principles of descriptive geometry and the solution of problems. The remaining time is devoted to the making of shop drawings and the application of the information derived in the first semester to the making of drawings for purposes of reproduction or construction in shop.

There are four sources from which we draw our information for the purposes of making drawings, viz:

(1) From models

(2) From description
(3) Other drawings
(4) Our own imagination

It is felt that in the high-school work that the first source is perhaps the one largely drawn upon and in our work in the first semester in the making of shop drawings the source is largely from description and other drawings but in the second semester of the advanced work the source of information is largely from the student's own creative imagination combined with the other sources.

The work is presented in the light of elementary design and offers drawings of electrical equipment to the students of electrical engineering, elementary jig and fixture design to the students of mechanical engineering, structural and topographical work for the students of civil engineering and drawings of chemical equipment to the students of chemical engineering.

It is found that a twofold purpose is accomplished by this system in that it retains the student's interest in his work and further makes him acquainted with terms and appliances which he will use in his course later.

As was formerly stated the regular course was for all students having less than 200 high school hours of drawing and for all other students who have had no drawing whatsoever. This being the case it is evident that the fundamentals and elements of the work must be covered and the work is presented largely from the standpoint of the art or the "how" of drawing.

The work is presented according to the following outline. First semester covering 108 hours:

(1) Lettering:

Forms and strokes of Gothic letters and figures.
Shop notes on drawings and titles etc.

(2) Orthographic projection.

Drawings from models and sketches.

Dimensioning and sectioning, notes, titles.
Assembly and detail drawing.
Simple structural and piping details.

(3) Reproduction:
Tracing.

(4) Freehand sketching:
Each drawing includes a freehand sketch of the object drawn.

Second semester covering 108 hours

(1) Pictorial Representation:
Theory and practice of isometric and oblique projection and drawing.

(2) Detail and assembly drawings:
Complete details of a machine from isometric drawing.
Details of a machine or structure from written instruction and sketches, requiring original thought and calculations using the standard handbooks.
Assembly drawing from details.

(3) Reproduction:
Blue printing theory and practice.

About one fourth of the drawing time is devoted to tests and problems. The tests are written quizzes and cover three or four drawing jobs. The problems are taken from descriptive geometry and deal with points, lines and planes; their representation and use. Problems in simple intersections of planes and solids also solids and solids are given.

However the time is too limited to give an adequate course in descriptive geometry for engineers and we hope to have such a course restored in the near future. It has been some 6 years since descriptive geometry as a course in the university was abolished.

Each job in drawing and each set of problems in the descriptive geometry work is preceded by a lecture covering

the main points and references are given to the work in the text. The important points covered are also posted so that they are available to all students. Questions covering each job are given on an Assignment to Drawing slip, which slip also contains brief instructions, references to text and title of sheet or job. The questions for the tests mentioned above are taken from the Assignment slip to each job.

Problems are administered by giving reference for outside study by lectures and by assigning a problem to be executed in class. Each problem requires a period of three hours.

As to the purpose of a course in Mechanical drawing, we realize fully the fact that engineering drawing is only a process in the development of the Engineer for the end to be obtained is not a draftsman but a man of the highest engineering professional type. We therefore strive in our work to keep constantly in the mind of the student the fact that the object and end of higher education is not for our own selfish ends alone but for the betterment of humanity in general. His general environments are such that he is led to feel that his every act and deed in the accomplishment of his work in mechanical drawing is an indication of the type of professional man that he will eventually turn out to be.

We also feel that above all other qualifications that the man of higher education must possess is that of leadership and that qualification stands out preëminently above all others. The ability to direct the minds of others will be his function in after life and on that account those men in our classes who possess the ability and knowledge are given an opportunity to exercise this qualification somewhat.

In the advanced section the class is divided up into squads of from 5 to 8 men and to each squad is assigned a leader, whose duty along with the execution of his own work, is to help those men in his squad in so far as he is able. He also does the grading and checking of the men of his squad, of course under the direct supervision of an instructor.

We find that this system while only an experiment is work-

ing wonderfully well and is giving the instructor more time to devote to the main questions of drawing which may arise in class and is giving the student the opportunity to round out his own knowledge by telling it to someone else, which we feel is the final test of a man's ability and seems to be a qualification which too few of us possess.

BUREAU OF PERSONNEL ADMINISTRATION.

To study and formulate the best methods of selection, transfer and promotion of public service employes is the primary function of the newly organized Bureau of Personnel Administration at Washington, D. C. Professor L. L. Thurstone, Head of the Department of Education and Psychology at Carnegie Institute of Technology, Pittsburgh, has been appointed Director of Research in charge of the bureau, effective January 1, 1923.

The Bureau is to be affiliated with the Institute of Government Research, and has been privately endowed subsequent to appeals for its establishment from the United States Civil Service Commission. An advisory board of five members of the national civil service commissions will supervise the operation of the bureau.

Mr. Thurstone and his associates will immediately take up the study of the selection, transfer and promotion on a basis of merit of all public service employes; classification of the positions in public service; methods of rating efficiency; reorganization of training courses for federal employes; recommendation of postal clerk and carrier tests; organization and procedure of district offices of the Civil Service Commission; and various other personnel problems outlined by the advisory board. Its field of work covers investigations of state and municipal employee problems in addition to those of the federal service.

COLLEGE NOTES.

Case School of Applied Science.—The number of the members on the faculty at Case School of Applied Science was slightly reduced this year, there now being 12 professors, 8 associate professors, 9 assistant professors, and 33 instructors, a total of 62. In addition to these are 2 professors emeritus, and about 15 special lecturers. The changes this year were fewer than usual, the most important being the engagement of Mr. Christian Nusbaum as assistant professor of physics, in place of Professor H. H. Lester, who went into commercial work. New instructors are: C. H. Chadborne in geology, R. W. Lewis in mathematics, F. L. Plummer in mathematics, C. J. Wertz in electricity, and H. G. Whitcomb in chemistry.

A new scale of salaries was announced in October, by which full professors will receive $5,000, associate professors $3,300, assistant professors $2,800, and instructors $2,000 to $2,200.

The local branch of the S. P. E. E. met on December 7 to discuss the Intelligence Tests. Dean T. M. Focke showed charts and graphs based on Case records, and four members of the faculty discussed special phases of the subject. Mr. G. H. Bost was elected secretary to fill an unexpired term. Professor Veazey is president.

The Polytechnic Institute of Brooklyn.—Among the educational activities is the work of a committee on educational policy. The personnel of the committee consists of six members of the Faculty appointed by the President of the college, Dr. Atkinson. In addition to the main committee, however, a series of sub-committees to consider specialized problems have been appointed from the instructing staff at large.

The scope of investigation of this combined committee is extensive and includes such matters as:

The value of a consistent practise in establishing prerequisite subjects.

The position, extent and service of optional technical and cultural subjects.

The study of a system of uniform grading and of efficient teaching methods.

The advantages of common Freshman and Sophomore years.

The possibilities of a three term college year in reducing the number of major subjects being taken simultaneously.

The position of the Thesis in the engineering curriculum.

The five year program for the engineer.

The findings of this committee when completed will be submitted to the Faculty for final action.

The Rensselaer Polytechnic Institute has recently installed in its radio laboratory a complete telephone broadcasting equipment. As this apparatus is used primarily for experimental purposes, it has been installed in separate units, so that each unit can be used independently of the rest of the equipment.

The power equipment, which consists of a high voltage direct current generator, and a low voltage direct current generator, both motor driven, is used as a direct current supply for the laboratory.

In the operating room, the low voltage amplifier, power amplifier, modulator and oscillator are installed in such a way that each may be used separately for general laboratory purposes.

Two independent circuits run from the operating room to the studio so that different types of microphones can be directly compared.

The sound absorbing construction in the studio is designed so that the amount and character of the reverberations produced in the studio can be varied at will, thus making the studio an ideal acoustical laboratory. The lighting system in this room has been arranged for studying the psychological effect of color and intensity of light upon the artists.

The antenna is supported by two steel towers, eighty feet high, on the roof of the Russell Sage Laboratory. The antenna is of the semi-rigid type, and each tower is equipped with machinery for quickly changing the antenna system to fit the various types of apparatus and wave-lengths used for transmitting.

When this apparatus is assembled and operated for general broadcasting purposes, results are obtained equal to those of the best commercial broadcasting stations, with respect to quality, strength and range of signals.

Programs are broadcast from this station, known by the call letters WHAZ, every Monday evening, at eight-fifteen o'clock, Eastern Standard time, and are heard throughout the United States, the Dominion of Canada, Mexico, Cuba and Porto Rico.

The Sheffield Scientific School's new Dean, Professor Charles Hyde Warren, is a graduate of the school and has served on the faculty of the Massachusetts Institute of Technology for over twenty years. Dean Warren succeeds Director Russell H. Chittenden, who has been at the head of the Scientific School since 1898.

Mr. Benjamin Britton Gottsberger, well known consulting mining engineer of New York City, is the new Professor of Mining Engineering. He is widely known as the active Secretary of the Mining and Metallurgical Society of America and as such has evinced a lively interest in educational problems.

The Sterling Chemistry Laboratory is practically completed and is now being used by all College and Scientific School classes. It has cost nearly $2,000,000 and is the largest university chemistry laboratory in the United States. The facilities for teaching engineering chemistry and power plant engineering at Yale are now exceptionally good. The building will be formally dedicated next April, on the occasion of the Spring Meeting of the American Chemical So-

ciety, an event which will bring to Yale some two thousand chemists and chemical engineers.

The Second Annual Machine Tool Exhibition was held in Mason Laboratory on September 21, 22, and 23, under the joint auspices of the New Haven Branch A. S. M. E., the New Haven Chamber of Commerce, and the university. This exhibition was on a much larger scale than that of last year; all available space in the laboratory was filled, and the building was crowded with visitors each day. Illustrated lectures were given, and moving pictures shown at afternoon and evening sessions.

Professor L. W. W. Morrow has been granted leave of absence for this year. He is serving as Associate Editor of the *Electrical World.*

Professor Royal D. Sloan, on a year's leave of absence from Montana State College, takes Professor Morrow's place this year in the Electrical Engineering faculty.

Mr. Paul H. Burkhart has been appointed Instructor in Electrical Engineering.

Other recent additions to the engineering teaching staff have been Mr. Ralph M. Trimble and Mr. Wilfred G. Geile in Engineering Mechanics.

Professor C. T. Bishop is Chairman, and Mr. T. K. Hendrick, Secretary of the Yale Branch of the S. P. E. E. The immediate problem before this local organization is a plan for instructing young instructors in the art of teaching. The university Department of Education, and in particular Professor J. C. Chapman, is rendering particularly practical and useful service at this point.

Professor C. J. Tilden was engaged all last summer on special research problems for the Bureau of Public Roads. He acts in a consulting capacity for the Bureau during the year.

Professor Lockwood, assisted by students and others, has conducted tests in the Mason Laboratory during the past year on Rolling Resistance of Rubber Tires, Heat Transmission, Automobile Radiators, Dynamometer Testing of Auto-

mobiles, Tractive Resistance of Heavy Auto Trucks, 4 Cylinder Buda Gasoline Motor, Strength of Iron Pipe Fittings, Air Flow Through Tin Plate Orifices, Friction of Ball and Roller Bearings. Professor Breckenridge conducted tests on Heat Transfer of Hot Blast Radiators, and Fuel Tests of High Volatile Coal in Heating Boilers, and Professor Waters on Design and Construction of a Domestic Refrigerating Machine using Ethyl Chloride.

University of South Carolina.—Professor Walter E. Rowe, head of the School of Engineering, is planning to operate the School beginning with the 1923–24 sessions on a five-year coöperative arrangement, six months in classroom followed by six months in the industries in successive alternation.

The School of Engineering of the University is desirous of establishing contact with other S. P. E. E. Branch members in the Southeastern District, especially regarding plans for coöperative courses. The present year is offering perplexing pedagogical problems; the courses may be said to be in a state of transition, or flux, as a result both of the expansion of opportunities for service to the State and of the necessity for altering the school's program to fit the needs of the industries as regards thoroughly trained graduates to study the economic problems pressing so hard at this time.

BOOK REVIEWS.

A Course in Analytic Geometry. BOYD, DAVIS, AND REES. D. Van Nostrand Co.

The first chapter reviews algebra and trigonometry in a brief but satisfactory way. In this review the statement is made that "$k/0$ can not be a number" but that "$0/0$ may equal any number." Better say also that $0/0$ can not be a number—that when an expression takes this form it fails to define a value—that such an expression may approach a limit as the independent variables approach the values at which the expression fails to have a meaning. The review in trigonometry, happily, includes problems in the solution of trigonometric equations.

The book is, as the authors state, more of a manual than a treatise. It thus avoids many of the confusing qualities of voluminousness so common, in recent text books. As a manual it is particularly complete and well planned. The order and classifications are upon the conception of mathematics as a science. The avowed underlying principals in both the plane and the solid analytic geometry are the ideas of (1) the locus of an equation and (2) the equation of a locus. The directions given for the discussion of an equation and the sketching of loci are clear and full. "Curves are classified according to the character of the function involved rather than by the degree of the equation." Polar coördination and polar curves justly receive more than the customary attention. The derivation is introduced on page 48. It is used in the determination of turning points and of tangents. Problems are numerous and well selected. An even greater number of easy problems placed near the theory would have improved the teachability of the test. The gain through the use of "outline letters and numbers" instead of the usual paragraph numbers is not great. The aims of the authors as stated in the preface have been attained and the

publication of the book is justified by the numerous ways in which it differs from any other text book now on the market.

K. D. S.

Rapid Arithmetic. T. O'Conor Sloane, Ph.D., LL.D. 190 pages, 5 x 7½. D. Van Nostrand Co.

This is a book evidently intended for beginners in mathematics, or for those intending to become computers, as very few proofs of the many rules are included. It would have increased the interest in the work, perhaps, to have added a few simple algebraic derivations, although such a procedure would certainly have dispelled much of the "mystery" which the author mixes with his subject.

Twenty pages are devoted to addition, with 15 methods presented; fourteen pages to subtraction, with 8 methods; thirty-five pages to multiplication, with 21 methods; thirteen pages to division, with three principal methods. Thus, too much space, 82 pages in all, is assigned to the "four fundamental processes of arithmetic." Particularly so, as three fourths of the whole number of methods are of very little practical use, and have scarcely any interest otherwise.

The inclusion of the "excess of nines proof" for multiplication and division is heartily commended by the reviewer, who thinks it should have been extended to the processes of addition and subtraction. The best of the methods described is "cross-multiplication," a process which might well be introduced into the higher grades of the public schools, both for its practicality and its mental discipline.

The latter half of the book is mostly devoted to curiosities in numbers, and includes many puzzles well calculated to draw the attention of young students. The author gives a slight impression in his book of a lack of scholarly care when he uses the obsolete word "computator" for "computer," and "ought" repeatedly for "naught," meaning a cipher. On the whole the book is a desirable collection of arithemetical processes and curiosities.

G. G. B.